NATIONAL WEATHER SERVICE
CHARLESTON, SC

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STORM COURIER

WINTER 2008-2009

Significant Weather Events of 2008

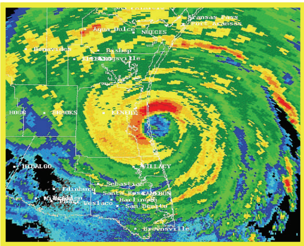
by Jon Jelsema - Meteorologist

What's Inside This Issue

The weather was unusually active across the South Carolina and Georgia low country in 2008, featuring numerous severe weather events, including a couple of significant tornado outbreaks. This kept forecasters at the National Weather Service (NWS) busy, issuing numerous watches, warnings and advisories!

On March 8th, a strong cold front moved through southern South Carolina and southeast Georgia, resulting in strong winds measuring between 50 and 60 mph which knocked down numerous trees and power lines across the area. An intense storm system impacted the low country on March 15th, resulting in a significant and highly unusual tornado outbreak. Damage surveys of four tornadoes ranging in strength from EF1 to EF2 were conducted by the NWS in southern South Carolina and of two EF2 tornadoes in southeast Georgia. In addition to the tornadoes, numerous reports were received of damaging winds and large hail. On May 11th (Mothers Day), another unusually strong storm system resulted in a second significant and extremely rare tornado outbreak. Once again, the NWS conducted damage surveys of two tornadoes ranging in strength from EF0 to EF2 in southern South Carolina, and of four tornadoes ranging in strength from EF0 to EF4 in southeast Georgia. Large hail and damaging winds were reported in addition to the tornadoes. Pop-up afternoon showers and thunderstorms were a common occurrence throughout the summer months of June, July, August and September, resulting in damaging winds, hail, flooding, and even a couple tornadoes. A few of the more significant severe weather events during the summer months included, an EF1 tornado which impacted the Savannah, GA metropolitan area on June 19th, an EF0 tornado that tracked through Johns Island, SC on June 30th, widespread flooding resulting from heavy rains in and around Hinesville, GA on July 14th, and extensive wind damage resulting from wind gusts of 60 to 70 mph in Beaufort, SC on August 7th. The combination of heat and humidity led to the issuance of several Heat Advisories and Excessive Heat Warnings in June and August, as heat indices rose well above 100 degrees. In fact, a couple locations measured heat indices of 118 degrees on August 6th. A couple tropical systems also affected the low country in late August and early September, and will be addressed later in the section reviewing the 2008 Hurricane Season. Following the active spring and summer months, the fall months of September through December were fairly tranquil with only a few severe weather events, allowing forecasters to finally catch their breath. One event in the fall was quite impressive however, when a vigorous storm system resulted in tremendous flooding in the Charleston, SC metropolitan area along with strong winds causing downed trees and power lines across much of the low country. For a more thorough review of the tornadoes which impacted southern South Carolina and southeast Georgia on March 15th and May 11th, along with several other of the more significant weather events of 2008, visit the following web page : http://www.erh.noaa.gov/chs/events.shtml.

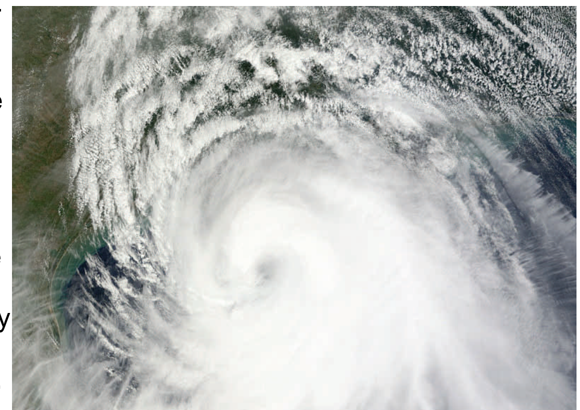
Throughout 2008, a total of 346 Severe Thunderstorm Warnings, 65 Tornado Warnings, 208 Special Marine Warnings, 21 Flash Flood Warnings, and a host of other advisory products were issued by the Charleston, SC NWS Office.



2008 Atlantic Hurricane Season: A Record Setting Year

by Robert Bright - Meteorologist

The 2008 Atlantic hurricane season, which officially ended on November 30, was one for the record books! As projected by the National Oceanic and Atmospheric Administration (NOAA), it was an above-normal season in terms of the number of tropical storms (16), hurricanes (8), and major hurricanes (5). A normal season has 11 tropical storms, six hurricanes, and two major hurricanes. Six consecutive hurricanes made landfall in the United States, which was a record. These storms include Dolly, Edouard, Fay, Gustav, Hanna and Ike. Hurricanes Gustav and Ike produced significant damage to the Gulf Coast region, with Ike being the seventh most costly catastrophe in U.S. history. Other records include the longest-lived July storm (Bertha) and five consecutive months of major hurricane (Category 3-5) activity.



Hurricane Ike - September 2008

There were only two storms which impacted the NWS Charleston County Warning Area while another system brushed the area. A tropical depression formed off the South Carolina coast on the evening of July 18 and moved northeast while strengthening into Tropical Storm Cristobal. However, there were no reports of tropical storm force winds over land associated with the storm. Tropical Storm Fay, which set a record for making landfall in Florida four times, made its third landfall near St. Augustine. The storm produced gusty winds, two to four inches of rain with isolated amounts near five inches and significant beach erosion across southern South Carolina and southeast Georgia. The final storm to impact the area was Tropical Storm Hanna, which approached South Carolina on September 6 before making landfall near the South Carolina-North Carolina border. Although Tropical Storm Warnings and Hurricane Watches were raised for portions of southern South Carolina and southeast Georgia, the tropical storm and hurricane force winds remained offshore. Similar to Fay, the main impact from this system was heavy rainfall with two to five inches reported mainly in coastal areas north of Beaufort.

For more information on the 2008 Atlantic hurricane season, check out the National Hurricane Center's website at http://www.nhc.noaa.gov.

2008 Hurricane Season

Arthur
Bertha
Cristobal
Dolly
Edouard
Fay
Gustav
Hanna
Ike
Josephine
Kyle
Laura
Marco
Nana

NOAA's National Weather Service Incident Meteorologist Program

by John Quagliariello - Senior Meteorologist

The National Weather Service (NWS) Incident Meteorologist program provides onsite meteorological support at wildfires and other incidents or events of national significance. Incident Meteorologists (IMETs) can be dispatched anywhere in the United States to provide continuous meteorological support for the duration of an incident. Once onsite, IMETs become key members of incident command teams. IMETs interpret weather information, assess the impact on the incident, brief key decision makers and help develop strategies for the protection of life and property.

In order to become a certified IMET, meteorologists receive extensive training, consisting of course work, field training and attendance at an annual Incident Support workshop. There are approximately 90 certified IMETs and 40 IMETs in training across the United States. The Charleston, SC NWS office has both a certified IMET and an IMET in training.

When an incident takes place, support is provided by the local NWS Weather Forecast Office until an IMET arrives, which usually takes about 12 hours from the initial notification. Typically, the closet IMET will respond to the initial notification request, but any IMET in the country can be dispatched depending on IMET availability and the particular need of the incident. IMETs often work 16 hour days, and for long duration incidents may provide onsite support for 14 consecutive days before being relieved by another IMET. During a typical day, IMETs maintain a continuous weather watch, issue site-specific weather forecasts and alerts, ensure weather equipment is functioning properly, and provide numerous briefings to those at the incident, the general public and conduct media interviews.

In order to provide the best possible support at an incident, IMETs are equipped with the “All Hazards Meteorological System” (AMRS), which consists of a laptop computer and both cellular and 2-way satellite communications so that weather information can be obtained even in remote locations. This system allows IMETs to become a “mobile” extension of the local NWS Weather Forecast Office. The laptops have special software that allows IMETs to view all the data necessary to maintain a continuous weather watch and provide weather forecasts and alerts. IMETs also use wind tracking weather balloons, Remote Automated Weather Stations (RAWS) and other meteorological tools to gather real time weather data.

Since the beginning of the century, there has been an average of 150+ IMET dispatches (or about 1340 dispatch days) per year, mainly in support of wildfires.

IMETs have also provided onsite support for the following incidents:

- Shuttle Columbia debris recovery (2003)
- Oil spill in Louisiana (2004)
- Oil spill from the M/V Selendang Ayu in Alaska (2004-2005)
- Post Hurricane Katrina support in Louisiana and Mississippi (2005)
- Greensburg, Kansas (2007), Eastern Nebraska and Parkersberg, Iowa (2008) tornado recovery support
- Democratic and Republican National Conventions (2004 and 2008)

NWS Charleston, SC IMETs have provided onsite support at the following incidents and exercises:

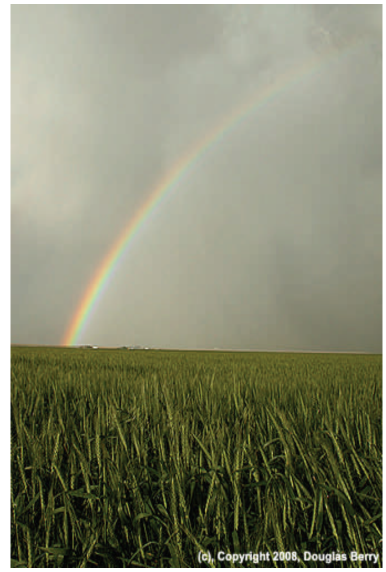
- Wildfire support in Oregon (2002)
- Wildfire support in the Custer National Forest, Montana (2003)
- Wildfire support in the Wenatchee National Forest, Washington (2003)

- Statewide wildfire support in Texas (2006)
- Wildfire support in the Klamath National Forest, California (2006)
- Wildfire support near Waycross, Georgia (2007)
- Wildfire support in the Okefenokee National Wildlife Refuge, Georgia (2007)
- National Guard “Vigilant Guard Exercise” in Beaufort, South Carolina (2008)
- Wildfire support in the Los Padres National Forest, California (2008)

2008 Rainfall Summary

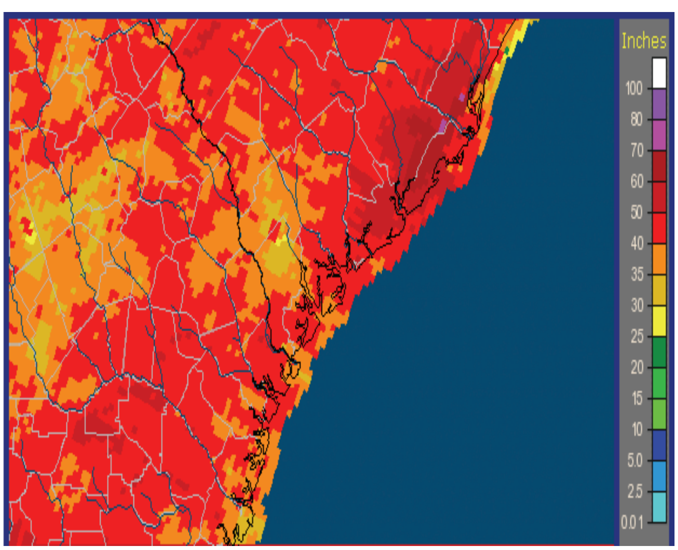
by Jonathan Lamb - Meteorologist

Although a multi-year drought continued into 2008 across much of southeast Georgia and southern South Carolina, rainfall totals for the year were near normal. The last year provides a great illustration of how complex drought declarations really are. If one looks solely at the annual rainfall total, it would seem as though rainfall patterns have been normal over most of the area. However, there were prolonged dry spells over the last year. Southern South Carolina was remarkably dry from January through March. Southeast Georgia was very dry in January, March, May, and September.

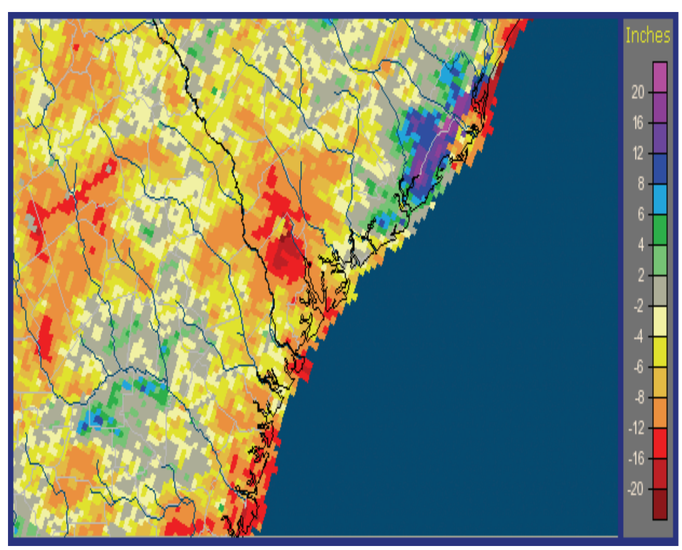


An uneven rainfall distribution from month to month can have profound impacts on water supplies, agriculture, power generation, etc. This variance cannot be seen in annual rainfall totals but must be incorporated into the drought status. A closer examination of monthly rainfall data exposes a weakness in monthly precipitation totals as well. The rain events were rarely distributed evenly throughout the month. In fact, a sizable chunk of the total precipitation for the year occurred during anomalous heavy rainfall events. This is significant because most of the water that falls during such episodes quickly runs off instead of infiltrating the ground and replenishing aquifers. Thus the freak rainfall events help create an illusion that a drought no longer exists despite having contributed little to groundwater replenishment. For example, nearly ten inches of Charleston's 2008 total can be accounted for in two freak events: 3.38" on 9/5 and 6.57" on 10/24.

A more accurate depiction of drought status can be ascertained from streamflow data. The U.S. Geological Survey operates several thousand surface water gage stations in the United States including more than 140 in SC and 260 in GA. They not only provide real-time flow data for creeks and rivers, but comparisons to "normal" flow values for a certain time of year. Most of the main-stem rivers that flow through our forecast area reported flows less than 10% of normal throughout the year. Several rounds of replenishing rain that fell in central SC and GA brought flows back to near normal in December. For the first time in about eight months we saw two of our river forecast points reach flood stage: the Ogeechee River at Midville, GA and the Ohoopee River at Reidsville, GA. This increase in areal rainfall is likely temporary, as the Climate Prediction Center is indicating a greater than 50% chance of below-normal rainfall during the first three months of 2009.

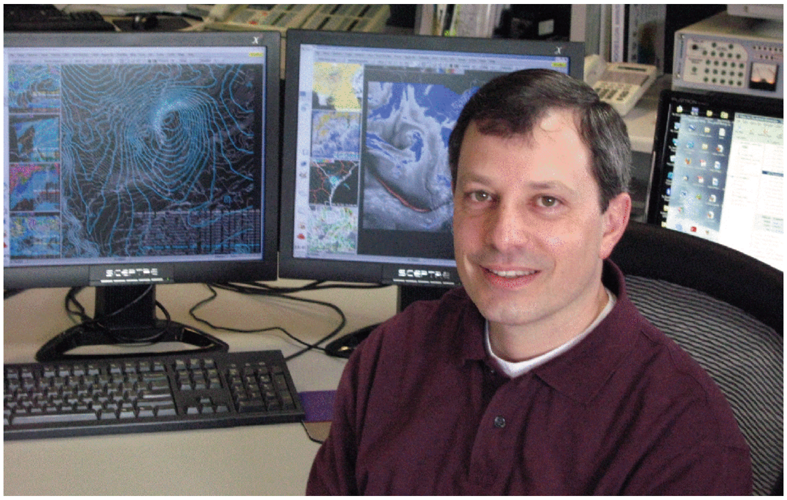


2008 Total Precipitation



2008 Departure From Normal Precipitation

New Warning Coordination Meteorologist at WFO Charleston



Back in late July 2008, Ron Morales arrived on station at the Charleston National Weather Service Forecast Office as the new Warning Coordination Meteorologist (WCM). Prior to becoming the WCM in Charleston, Ron served as the Science and Operations Officer (SOO) at the Corpus Christi, TX NWS office for four years. Ron's main duties as the SOO were to lead the research and training efforts for the local office. Ron also spent more than 10 years as a lead forecaster at the Tampa Bay, FL NWS office. Given that Ron has spent almost 15 of his 17 year career in the National Weather Service around the Gulf of Mexico, he has seen his share of severe and tropical weather. Despite Ron's experience in the more tropical latitudes, it was actually winter weather that intrigued Ron at a very young age, and ultimately inspired him to study meteorology. Ron is very excited about working at the Charleston office since its geographic location will allow him to see a little bit of virtually every type of weather, from severe storms, to tropical systems, to the occasional winter weather event.

For the past few months, Ron has been working very hard with forecaster Jon Jelsema and Lead Forecaster Steve Taylor with renewing the Storm Ready status for 18 of our 20 counties in South Carolina and Georgia. Storm Ready is a program that was developed by the National Weather Service several years ago to help counties, cities, communities and businesses become better prepared to both monitor and respond to severe weather. For more information on Storm Ready, please see the following link:

http://www.nws.noaa.gov/stormready/index.html

In addition to Storm Ready efforts, Ron has also been focusing on providing Skywarn Spotter training to many counties across Charleston's forecast area. It is estimated that between 200 and 300 new weather spotters will be trained by the end of this April. If you are interested in attending one of the upcoming SkyWarn Spotter training sessions in 2009, please refer to the following link: http://www.erh.noaa.gov/chs/spottertraining.txt.

Finally, in addition to providing office tours, outreach presentations to schools and civic organizations, Ron will continue to make every effort to visit all of the county Emergency managers, media partners and local HAM Radio folks across Charleston's area of responsibility, which covers eight counties in South Carolina and 12 counties in southeast Georgia. The success of the WCM position hinges heavily on providing service to our customers and to our community in general. Ron feels that the best way to provide such service is through developing strong professional and personal relationships with as many of our customers as possible.

Science Corner: Waterspouts

by Pete Mohlin - Senior Meteorologist

CLIMATOLOGY and STATISTICS

A waterspout is defined as a rapidly rotating column of air extending from the base of moderate or towering Cumulus clouds to the surface of the water. Only rarely does the visible funnel extend from the cloud base to the sea surface. However, you can assume if the funnel extends at least halfway between the cloud base and the surface of the water, that there is an invisible funnel extending all the way down.

Waterspouts will form in areas of low-level convergence where swirls of colliding air become vertically extended and intensified by rapidly growing clouds. Waterspouts will climb skyward from the water's surface to the cloud base. This is different for tornadoes, which develop from a mesocyclone, or a large rotating thunderstorm, with roots in the middle levels of the atmosphere that grow downward to the surface.

Waterspouts over the waters of the southeast are primarily a warm season phenomenon (June through early September), and this coincides well with water temperatures above 80° F. Most waterspouts that occur in local waters are referred to as "fair-weather" or "non-tornadic" waterspouts. Wind speeds in waterspouts are at least 35 knots, or gale force, but many can generate hurricane force winds greater than 60 knots. With wind speeds such as these, waterspouts can be just as dangerous as tornadoes and they can cause significant damage or even loss of life.

The winds associated with waterspouts may circle clockwise or counterclockwise, and its diameter of circulation may be as much as 200 feet. Waterspouts vary widely in size and shape, but most have ropelike funnels that extend downward from dark, flat Cumulus cloud bases. Research has shown that approximately two-thirds of observed waterspouts have a maximum funnel diameter of 80 ft or less; the remaining one-third have maximum diameters of 100 ft or more at some point during their lifecycle.

Thunder and lightning are present in only about 30% of waterspout occurrences. The average duration of non-tornadic waterspouts is generally 15 minutes, and oftentimes less. Non-tornadic waterspouts move slowly, and they usually form in uniform and mostly calm conditions. Most non-tornadic waterspouts are reported during the morning or early afternoon, the time when the sea breeze and other boundaries are most prominent over the Atlantic waters.

In the local waters, multiple waterspout sightings (two or more occurring simultaneously or more than one event in the same day) occur about 25% of the days when waterspouts and/or funnel clouds are reported. In 2008 there were reports of waterspouts received on three separate occasions in the local area; two off Folly Beach, SC on June 12; four off the coast between Tybee Island, GA and Fripp Island, SC on July 7; and one off Edisto Beach, SC on August 1. This is a typical year, as we usually receive waterspout reports three or four times a year.

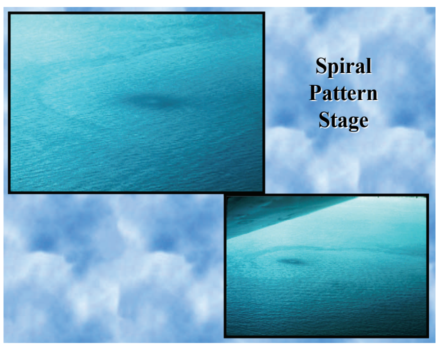
Some Significant Differences Between Tornadic and Non-Tornadic Waterspouts

- Tornadic waterspouts are tornadoes over water and are usually more dangerous than non-tornadic waterspouts.
- Tornadic waterspouts occur more often with squall lines, severe weather, strong winds in the atmosphere, and during chaotic or disturbed weather conditions.
- Tornadic waterspouts are much greater in size and intensity than non-tornadic waterspouts.
- Tornadic waterspouts occur most frequently in the afternoon and evening, much like tornadoes over land.
- Tornadic waterspouts will move as fast as 15 to 30 knots.
- Tornadic waterspouts can last 30 - 60 minutes, or 2 to 3 times longer than non-tornadic waterspouts.
- Tropical systems decrease the likelihood of non-tornadic waterspouts, but increase the chances for tornadic waterspouts.

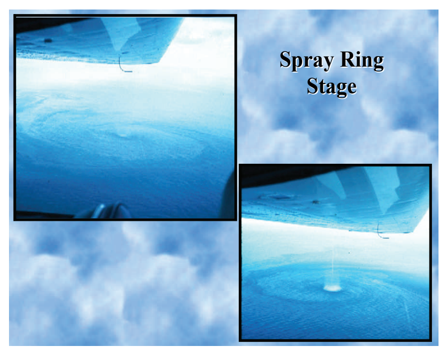
Waterspout Life Cycle

The waterspout life cycle is characterized by 5 stages; the “dark spot stage”, the “spiral pattern stage”, the “spray ring stage”, the “mature stage” and the “decay stage”.

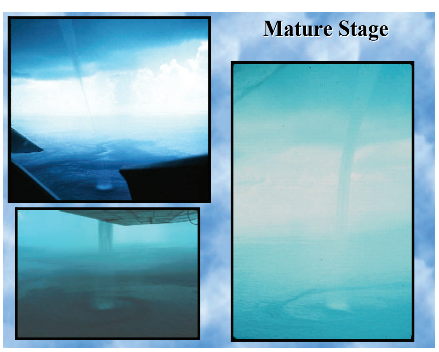
1) The ***"dark spot stage"***, characterized by a prominent light-colored disc on the sea surface, surrounded by a dark patch diffuse on its outer edges--the dark spot may or may not have a small funnel cloud above it initially, but signifies a complete vortex column extending from cloud base to sea surface.



2) The ***"spiral pattern stage"***, the primary growth phase of the waterspout, characterized by development of alternating dark and light-colored bands spiraling around the dark spot on the sea surface.



3) The ***"spray ring stage"***, characterized by a concentrated spray ring around the dark spot, with a lengthening funnel cloud above.



4) The ***"mature waterspout stage"***, characterized by a spray vortex of maximum intensity and organization, the gradual weakening of the spiral pattern, and maximum funnel cloud length and diameter.

5) The ***"decay stage"***, when the waterspout dissipates (often abruptly) as it is intercepted by the cool downdrafts from a nearby rain shower.

Waterspout Forecasting

Mature waterspouts contain wind speeds in excess of 35 knots and as such, it has been the custom in the NWS to issue a "Special Marine Warning" in order to warn mariners of the potentially hazardous winds. If our forecast confidence is high we will attempt to give more advance notice of waterspouts that may occur in the Area Forecast Discussion, the Hazardous Weather Outlook and a Marine Weather Statement.

Waterspout (*Non-Tornadic*) Forecasting Factors

- Weak vertical shear in the lower levels of the atmosphere, with an average wind speed less than 10 knots from the surface through approximately 25,000 feet.
- Convective instability in the lowest 10,000 feet of the atmosphere.
- Abundant low level moisture with dry air above.
- Updrafts of weak to moderate strength.
- An approaching weak boundary such as the sea breeze to provide a lifting mechanism.
- Lines of Cumulus clouds, especially if they are intersecting. Cloud lines are extremely important in that very few waterspouts will occur in isolated cumulus clouds. Individual shower outflows or downdrafts in the cloud line act to concentrate the weak spin in the air. Then an updraft in an adjacent part of the cloud line further produces weak spin, forming the spiraling flow and the waterspout itself.
- Temperature gradients, such as those that occur in cool-air outflow boundaries.
- Most occur in developing Cumulus (Cumulus Mediocris) or Towering Cumulus clouds (Cumulus Congestus), but usually not Cumulonimbus clouds. The maximum cloud tops are about 25,000 ft, but more commonly between 10,000 and 15,000 ft.
- Warm Sea Surface Temperatures (the minimum temperature necessary for waterspout development is usually around 78° F. Of the documented waterspout events in the local coastal waters over 80% occurred with the sea surface temperature of 80-85° F)
- Continuity from previous day(s).

WATERSPOUT SAFETY RULES

Your best course of action if you spot a waterspout is to determine the direction it is moving, then move in a direction away from the waterspout. If a waterspout does not appear to be moving, then it may be approaching your position. Again, move in a direction away from that movement. Proceed with caution and make sure all are wearing approved personal flotation devices (PFD). If possible get to a safe harbor. When in a safe location, contact the National Weather Service with your report of the waterspout. Provide its location, along with its direction and speed of travel if known.

NATIONAL WEATHER SERVICE
CHARLESTON, SC

5777 South Aviation Avenue
N. Charleston, SC 29406-6162

Phone: (843) 744-0303
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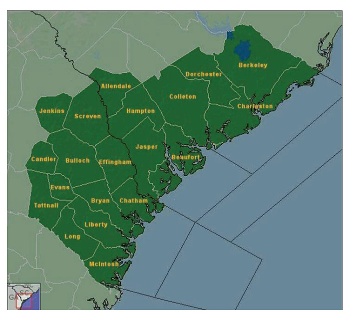
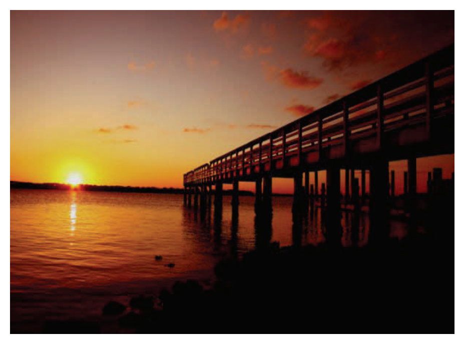
NOAA AND THE NATIONAL WEATHER SERVICE...WORKING TOGETHER TO SAVE LIVES!





Whenever severe weather strikes, remember, as a trained weather spotter *we want to hear from you*! If you measure or estimate winds of 50 mph or greater, observe trees and/or power lines down, structures damaged, hail (any size), flooding (water running across the road, ditches overflowing, creeks/streams out of their banks), tornadoes, funnel clouds or waterspouts, pick up the phone and call us. In addition, if you see or hear of any injuries, fatalities, or damage from lightning, give us a call. Your valuable reports help us confirm what we're detecting on radar, and could make a life-or-death difference for the people in the next town or in the next county about to be hit by the severe storm that just went over your house. *When in doubt, please call us!*

If you take any interesting pictures of weather phenomena, we would love to see them. You can e-mail your digital pictures to our Skywarn account at ***chs.skywarn@noaa.gov***

You can always call the toll-free number we provided to you during the training.

Or, leave a report on our severe weather answering machine :
1-888-383-2024

E-mail reports and pictures to:
CHS.SKYWARN@NOAA.GOV

Forecasts & Conditions:
843-744-0303